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ABSTRACT

This study investigated interaction and achievement in cooperative small groups in four junior high school mathematics classrooms. Ninety-six students learned a one-week unit on consumer mathematics in mixed-ability or uniform-ability groups. Students in mixed-ability groups scored higher on a problem-solving test than students in uniform-ability groups. However, this finding was mediated by verbal interaction within the group. Asking a question and receiving no answer was detrimental to achievement. This behavior was more frequent among uniform-ability groups than among mixed-ability groups. Group interaction was predicted by group composition (uniform-ability or mixed-ability), student personality (extroversion-introversion), and student ability. (Author)

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GROUP COMPOSITION, GROUP INTERACTION AND ACHIEVEMENT IN COOPERATIVE SMALL GROUPS

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Paper presented at the Annual Meeting of the American Educational Research Association, Los Angeles, April 1981.

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Abstract

This study investigated interaction and achievement in cooperative small groups in four junior high school mathematics classrooms. Ninety-six students learned a one-week unit on consumer mathematics in mixed-ability or uniform-ability groups. Students in mixed-ability groups scored higher on a problem-solving test than students in uniform-ability groups. However, this finding was mediated by verbal interaction within the group. Asking a question and receiving no answer was detrimental to achievement. This behavior was more frequent among uniform-ability groups than among mixed-ability groups. Group interaction was predicted by group composition (uniform-ability or mixed-ability), student personality (extroversion-introversion), and student ability.

Group Composition, Group Interaction and Achievement in Cooperative Small Groups

Interest in cooperative learning has burgeoned during the past few years. Much of the research on cooperative groups has focused on achievement, generally showing advantages of cooperative settings over competitive or individualistic settings (see, for example, the recent extensive reviews by Sharan, 1980; and Slavin, 1980a,b). The results of studies comparing achievement in cooperative uniform-ability and mixed-ability small groups, however, have been mixed. Mixed-ability grouping produced higher achievement than uniform-ability grouping for all students (Amaria, Biran, & Leith, 1969), for high-ability but not low-ability students (Beane & Lemke, 1971), and for high-ability and low-ability but not medium-ability students (Webb, 1980a, b, Note 1).

Most of the research on cooperative groups has not, however, systematically investigated the interactional processes which give rise to higher achievement in certain group settings. Discussion of interaction typically consists of post hoc speculation or investigators' impressions after observing groups at work.

To understand how group settings influence achievement, researchers need to focus on interaction as a mediating variable between the group setting and achievement. The results of the few studies that have identified students' roles in group interaction and related these roles to achievement suggest that interaction may be a key predictor of achievement. In one study, better performance was associated with active participation in the group (Webb, 1980a, b, Note 1). Students who gave or received

explanations of how to complete the task scored higher than did students who did not actively engage in group interaction. These roles in group interaction helped to explain the aptitude-treatment interaction (ATI) between ability and kind of grouping described above. High-ability students taught low-ability students in mixed-ability groups, and participated less in uniform-ability groups. Medium-ability students, left out of the discussions in mixed-ability groups, actively helped one another in uniform-ability groups. Peterson and Janicki (1979), studying learning in small and large group classroom settings, also found that students benefited from teaching their peers. But the recipients of the explanations did not benefit. Whereas the above studies used total scores on achievement tests, another study focused on a specific problem in a more intensive analysis of group interaction (Webb, 1980c). In that study, receiving an explanation about the problem was highly correlated with test scores on that problem.

To verify the importance of group interaction for learning, the present study investigated the relationship between students' interaction and their achievement in mixed-ability and uniform-ability groups in junior high school mathematics classrooms. In addition to group composition, the following characteristics of the student were included as predictors of achievement and interaction: ability (shown by Peterson & Janicki, 1979, and Webb, 1980a,b, Note 1 to relate to a student's role in group interaction) and extroversion-introversion (shown by Hare, 1976, to relate to participation in group settings). The present study explored the function of group interaction as a mediating variable between group and individual characteristics and achievement.

Method

Sample

The sample consisted of 96 students in grades 7, 8, and 9. The students came from two average and two above-average general mathematics classes at a junior high school in the Los Angeles metropolitan area. Average mathematics and reading stanine scores of the Comprehensive Test of Basic Skills (CTBS) ranged from 3 to 9 in this sample. Approximately 40 percent of the students in these classes were minority. Because the mathematics classes at the school are tracked by ability rather than by grade, each class had students from all three grades. One volunteer teacher taught two average classes; the other volunteer teacher taught two above-average classes.

Classroom Setting

The setting for the study was a special classroom designed to complement the regular mathematics curriculum with manipulative materials. In this classroom, students work in small groups, with instruction from the teacher when needed. Mathematics teachers have the option of taking their classes to the special classroom for week-long visits as often as they wish.

Instructional Materials

The topic of the instructional materials was consumer mathematics. The unit on consumer mathematics consisted of four activities, each completed

on a different day. The activities were (1) "Restaurant Rendezvous"--reading menu prices, calculating tip and tax; (2) "Meals at Home"--calculating the costs of meals at home using grocery store prices and amounts; (3) "Clothing"--ordering clothing from a catalogue, calculating sales tax; and (4) "Checking Accounts"--balancing a checkbook, calculating the amount of a deposit less cash received.

To enable the groups to check their answers to the questions in the activities and to provide clues for solving the problems, all groups had access to answer sheets.

Instrumentation

Achievement test. At the end of the unit on consumer mathematics, all students took an achievement test. The test consisted of one multiple-part item corresponding to each activity in the unit. Credit was given for a part of an item if the answer was calculated correctly from earlier answers given; therefore, the accuracy of one part of an item did not depend on the accuracy of another part. The scale of the test ranged from 0 to 40 points. Internal consistency α for the achievement test was .81.

Questionnaire. At the end of the study, students completed a two-part questionnaire. The first part of the questionnaire was the extroversion-introversion scale of the Eysenck Personality Inventory (Eysenck & Eysenck, 1968). High scores (maximum of 24) are indicative of extroversion. For this sample, internal consistency α for the extroversion-introversion scale was .56.

The second part of the questionnaire was an open-ended question asking the students to indicate whether they liked working in small groups and to describe their reasons.

Observation instrument. The observation instrument was designed to assess interaction among students in a group and interaction between the teacher and students. Each observer wrote notes about all interaction in the group, noting the speaker and recipient of each interchange, the observation category, and, whenever possible, the content of the interchange. To assess the generalizability of the observations, a generalizability study (Cronbach, Gleser, Nanda, & Rajaratnam, 1972) was conducted in which two observers observed the groups simultaneously on two days. From her own set of written notes, each observer made a tally of the number of occurrences of each observation category. The observation categories included in this study were shown by previous research (e.g., Peterson & Janicki, 1979; Webb, 1980a,b,c, Note 1) to be related to achievement in small groups. The observation categories and their estimated generalizability coefficients (ρ^2) for one observer and four days were: student gives help, $\rho^2 = .86$; student receives help, $\rho^2 = .67$; student asks a question, $\rho^2 = .97$; student asks a question and receives no response, $\rho^2 = .91$; student works alone, $\rho^2 = .82$; student interacts with another student (task-related, nonspecific), $\rho^2 = .87$; and student is off task, $\rho^2 = .80$. These coefficients were judged to be high enough that one observer observing a group at any one time was sufficient.

rho squared

To determine whether different raters might score one set of notes differently, a generalizability study was conducted in which two observers scored the notes made by one of the observers on five days. The estimated generalizability coefficients for one scorer ranged from .83 to .93, indicating that one scorer was sufficient.

Procedure

Assignment of students to groups. One week before the start of the study, teachers assigned students to groups on the basis of alphabetical order and student choice subject to the following constraints. Close friends were placed in separate groups, as were students who disliked each other. Further, the highest-achieving students were not placed in the same group, nor were the lowest-achieving students. Most groups had four students; some had three.

After groups were formed, the ability composition of each group was determined. The ability measure used in this study was the mean of the mathematics and reading stanine scores of the Comprehensive Test of Basic Skills (CTBS). Three ability strata were defined--high, medium, and low--corresponding approximately to the top 25%, the middle 50%, and the bottom 25% of the sample. Uniform-ability groups had students from the same ability stratum. Mixed-ability groups had students from more than one ability strata[1]. Half of the groups were uniform; half were mixed. Table 1 gives ability data for the sample. Because the mean of the sample was above-average, students were low or medium relative to the sample, not in absolute terms.

Table 1 about here

Because the classes were tracked by ability, the two average classes consisted primarily of medium-ability and low-ability students, and the two above-average classes consisted of medium-ability and high-ability students. Consequently, mixed-ability groups had either medium-ability and low-ability students or high-ability and medium-ability students. No group could have high-ability and low-ability students.

To determine whether uniform-ability and mixed-ability groups were comparable, background characteristics of the students were analyzed. The difference in mean ability scores of the two grouping conditions (see Table 1) was not statistically significant ($F = .51$, $df = 1,94$, $MS_e = 2.03$, $p < .48$). Furthermore, the difference in mean extroversion-introversion scores of the two grouping conditions (see Table 1) was not statistically significant ($F = 1.40$, $df = 1,94$, $MS_e = 6.22$, $p < .24$). Grouping conditions were also comparable with respect to sex and ethnic background: uniform-ability groups had 51% of the female students and 46% of the male students in the sample ($\chi^2 = .08$, $df = 1$, $p < .80$); and uniform-ability groups had 50% of the white students and 43% of the minority students in the sample ($\chi^2 = .16$, $df = 1$, $p < .70$). Each teacher had similar numbers of uniform-ability and mixed-ability groups. One teacher had 59% of the uniform-ability groups and 41% of the mixed-ability groups ($\chi^2 = .22$, $df = 1$, $p < .60$)

chi squared

Although grouping conditions were comparable on all measured characteristics, other factors such as preference for working together or friendship may have systematically related to group composition. The teachers did not, however, note a higher incidence of friendships in one kind of grouping than in the other. Generalization of the findings, therefore, is probably not limited by the assignment procedures. In any event, to be truly systematic, replications of this study should use random assignment procedures.

Classroom activities. On the first day, students received their group assignments and their schedule of activities for the week. Activities were assigned to groups according to a Latin Square design so that groups worked on activities on different days during the week.

Students were told to work together and not to divide the work, to help group members experiencing difficulty and to ask for help if they needed it. They were instructed to check the answer sheet or ask the teacher for help only if no one in the group could solve the problem. To further promote cooperation among group members, groups participated in an intergroup competition: each group's score was the average of the test scores in the group. The group with the highest score received a prize. The reward structure was, therefore, intergroup competition-intragroup cooperation (see Michaels, 1977); groups competed for rewards but group rewards were distributed equally within each group. Deutsch (1949, 1960) found that this reward structure promoted cooperation, helpfulness, and coordination of efforts among group members.

During group work, students in a group worked on one set of materials. The teacher monitored group work by answering questions, by providing hints when groups could not proceed, and by ensuring that students worked on the task and did not bother other groups.

Each group was observed for approximately seven minutes during each class period. The order in which groups were observed was counterbalanced (using a Latin Square design) so that each group was observed at different times during the class period. Because the observers had visited the classes on previous occasions to familiarize the students with their presence, most students ignored them. Occasionally, students asked the observers for help; the observers directed them to the teacher.

Assessment. During the week after small-group work, students completed the achievement test and the questionnaire. Students worked individually on the test and on the questionnaire.

Results

Achievement in Uniform-ability and Mixed-ability Groups

The means and standard deviations for achievement appear in Table 1. Students who worked in mixed-ability groups scored higher on the achievement test than students who worked in uniform-ability groups. The difference in achievement, tested with analysis of covariance with student ability as the covariate, was statistically significant ($F = 5.15$, $df = 1,93$, $MS_e = 52.11$, $p < .03$).

Observations of Group Interaction

To attempt to explain the higher achievement in mixed-ability groups than in uniform-groups, interaction in groups was compared across grouping conditions. Table 1 shows the means and standard deviations for each observation category. Because each student was observed for about 28 minutes during the week, each mean represents the number of instances of a group interaction variable in half a class period.

The differences in interaction between the grouping conditions were tested using multivariate analysis of variance. The interaction variables were divided into two sets, representing the dimensions thought to underlie group interaction: (1) active participation in the task (gives help, receives help, asks a question, asks a question and receives a response, works alone, and interacts with another); and (2) no (task-related) active participation (receives no response to a question and behaves off-task). The difference between grouping conditions on the first dimension, active participation, was statistically significant (Wilks' Lambda = .84, $df = 6,89$, $p < .02$). The means in Table 1 show that students in mixed-ability groups gave help more often to fellow group members, received more responses to

questions, and worked more often with other group members (without specifically helping, receiving help or asking questions) than students in uniform-ability groups, whereas students in mixed-ability groups received help less often, asked fewer questions, and worked alone less often than students in uniform-ability groups. (The means and standard deviations for giving help did not equal those for receiving help within a grouping condition because (1) students did not always pay attention to help being offered, and (2) groups occasionally received help from the teacher.) The difference between grouping conditions on the second dimension, no active participation, was also statistically significant (Wilks' Lambda = .86, df = 2,93, $p < .001$). The means in Table 1 show that students in mixed-ability groups were ignored less often when they asked questions and were off-task less often than students in uniform-ability groups.

To determine whether any specific variable might have accounted for the differences in interaction between uniform-ability and mixed-ability groups, univariate t tests were performed using a conservative significance level (.005) to take into account the number of statistical tests being performed and the correlations among the variables. The only interaction variable that showed a statistically significant difference between grouping conditions was "student asks a question and receives no response" (t = 3.86, df = 94, $p < .001$). (The other statistical tests showed probability levels of .18 or higher.) Translating the means in Table 1 to frequency per class period shows that this interaction event occurred once in 26 minutes on the average, or twice a class period, for a student in a uniform-ability group, whereas for a student in a mixed-ability group it occurred once in 90 minutes, or once in about two class periods.

Not only was receiving no response to a question the sole interaction variable that discriminated between grouping conditions, it also had the

strongest relationship with performance on the achievement test. Students who did not receive answers to their questions obtained lower test scores than students who did receive answers to their questions (r = -.54, p < .001). Only one other interaction variable was related to achievement: asking a question and receiving a response (r =.19, p < .03). To determine whether asking a question and receiving a response helped predict achievement over and above asking a question and not receiving a response, a stepwise multiple regression analysis was performed with the two interaction variables predicting achievement. (The correlation between the interaction variables was -.18.) When asking a question and not receiving a response was taken into account, asking a question and receiving a response did not predict achievement (F = 1.19, df = 1,93, p < .30, increment in R^2 < .01).

In summary, the only interaction variable that discriminated between uniform-ability and mixed-ability grouping and strongly related to achievement was asking a question and receiving no response. Students in uniform-ability groups received no answers to their questions more often that students in mixed-ability groups did, with detrimental effects on their test performance.

Personality

The extroversion-introversion scale was administered to determine whether personality of the students influenced their roles in group interaction.[2] It was hypothesized that extroverted persons would participate more actively in group interaction that would introverted persons and, more specifically, would be more aggressive in asking for help and more successful in obtaining it. The correlation between scores on the extroversion-introversion scale and the number of times that students asked questions and received no response confirmed the hypothesis: extroverted students tended to be ignored less often that were introverted students (r = -.18, p < .05).

Explanatory Input-Process-Outcome Model

An explanatory model was constructed in which interaction in the group mediates the effects of the input variables--group composition, student personality[3], and student ability--on the outcome variable, achievement. The model was estimated and tested using path analysis. Figure 1 presents the final input-process-outcome model and Table 2 presents data regarding the fit of the data to the final model. The actual and reproduced zero-order correlations are virtually identical, indicating a good fit (for a description of the procedures in path analysis, see Bentler, 1980; Duncan, 1975; Wolfle, 1980).

Figure 1 and Table 2 about here

The final model in Figure 2 partially confirmed the hypothesized model. Group composition and student personality had no direct effects on achievement, but they did have indirect effects on achievement through interaction in the group. Although the effect of student ability on achievement was partially mediated by interaction in the group, ability did have a strong direct effect on achievement, which is consistent with most educational research. What is striking in the model presented here, however, is that interaction in the group had as strong a direct effect on achievement as student ability did. Among students with the same ability, students who did not receive answers to their questions did worse than students who did obtain answers to their questions.

Student Attitudes and Impressions

To determine whether students had any insights into group processes, their impressions of group work reported on the questionnaire were analyzed. Most students (81%) indicated that they enjoyed working in groups. Whether they enjoyed group work did not, however, relate to any group interaction variable.

What did relate to measures of group interaction were the reasons that students gave for liking group work. Some students reported that they could get help from other group members, for example, "Yes, because the people at my table helped me and I helped them". The remaining students gave general reasons for liking group work, for example, "Yes! It was more interesting than sitting in a stuffy class". Students' reasons for liking group work were scored dichotomously: they either did or did not mention receiving help. The relation between students' reasons for liking group work and interaction in the group was assessed with a point-biserial correlation between the reasons and the number of times that students asked a question and received no response. The correlation was statistically significant ($r = -.22$, $p < .04$). Students who received answers to their questions were more likely to include receiving help as a reason for liking group work than were students who did not receive answers to their questions. This result suggests that those students who experienced certain aspects of group interaction, viz., received help, were aware of group processes and that their perceptions of group interaction tended to coincide with the outside observers' impressions.

Discussion

Summary of the Findings

The analyses of group and individual characteristics, interaction in the group, and achievement revealed two important findings. First, students in mixed-ability groups scored higher, on the average, than students in uniform-ability groups. Second, and more importantly, interaction in the group mediated the effects of some group and student characteristics on achievement. Asking a question and receiving no answer was detrimental to achievement, and uniform-ability groups produced more of this behavior than mixed-ability groups did. Within one type of grouping, low-ability

students (and introverted students) were more likely than high-ability students (and extroverted students) to receive no answers to their questions.

Psychological Interpretations of the Findings

This section describes social and psychological mechanisms hypothesized to explain the following findings: (1) the negative effect on achievement of asking a question and receiving no answer, (2) the higher frequency of that interaction variable in uniform-ability groups, (3) its higher frequency among introverted students, and (4) its higher frequency among low-ability students. Whenever possible, supporting evidence from observations of group interaction or students' responses on the questionnaire will accompany hypothesized explanations.

By asking questions students clearly indicated that they did not understand, or were not sure they understood, how to obtain the correct solution to the problems. Of the questions asked, 75% reflected uncertainty about how to solve the problems (e.g., "I don't understand. What do we do here?"); 20% concerned specific information needed to solve the problems (e.g., "What does net [amount] mean?"); and 5% requested other students' answers (e.g., "What did you get?"). Without receiving responses to their questions, students were not able to correct their misunderstandings or lack of understanding. A further analysis that would help confirm this explanation would link instances of not receiving a response to a student's achievement on the content of the questions (see, for example, Webb, 1980a,c).

The available data did not account for the higher frequency of asking a question and receiving no answer among uniform medium-ability and high-ability groups. In uniform low-ability groups, however, receiving no answer may have been related to off-task behavior. The incidence of off-task behavior was significantly higher in uniform low-ability groups than in other groups ($t = 4.13$, $df = 94$, $p < .001$). Furthermore, nearly half of

the students in these groups complained about off-task behavior on the questionnaire. It was probably difficult for students to obtain answers from students who tended not to pay attention to the task. The off-task behavior may have resulted from frustration at being unable to do the task (see, for example, Berkowitz & Levy, 1956; Hackman & Morris, 1975; Hammond & Goldman, 1961; Steiner, 1972). The tendency of mixed-ability groups to answer members' questions may be related to a sense of responsibility toward group members. Over half of the students in mixed-ability groups, in contrast to 20 percent of the students in uniform-ability groups, expressed the importance of helping others, for example, "You're around people who are smarter and people who are not so bright and you get to help them out, and helping someone is where it's at."

The tendency of introverted students to fail to obtain answers to their questions more often than extroverted students did is consistent with the literature finding positive correlations between interpersonal behavior in groups and scales that measure dominance, aggressiveness, and extroversion (Aronson & Weintraub, 1967; Gold, DeLeon, & Swensen, 1966; Hare, 1976; Leader, 1973; Lerea & Goldberg, 1961; Moerk, 1972; Sales, 1971; Stern & Grosz, 1966; Wagoner & Grosz, 1971). In the absence of direct observations, however, the result in the present study cannot be explained further.

The tendency of low-ability students to obtain answers to their questions less often than high-ability students contradicts previous findings of negative or zero correlations between ability and receiving help (see Peterson & Janicki, 1979; Webb, 1980d). More data are needed to explain these discrepant findings.

Interaction in the Group: A Key Predictor of Achievement

One major implication of the findings is that an individual's experience in the group can have as great an effect on achievement as the individual's ability, which typically is the strongest predictor of achievement in educational research. Another implication is that a student's achievement and experience in group settings cannot be predicted from only characteristics of the student nor from only characteristics of the group (for further discussion of this point, see Bidwell & Kasarda, 1980). In this study, group composition, student personality and student ability helped predict interaction and achievement.

It should be noted that the relationships established in this study apply to the variables as defined here and for the content examined here. The relationship between group composition and achievement, for example, may depend on the rule for allocating students to groups. When mixed-ability groups had high- and medium-ability students or medium- and low-ability students (the present study), mixed-ability grouping was beneficial at all ability levels. When mixed ability groups had highs and lows but no mediums (Beane & Lemke, 1971), mixed-ability grouping was beneficial only for highs. When mixed-ability groups had one high, one low and two mediums (Webb, 1980a,b, Note 1), mixed-ability grouping was beneficial for highs and lows but not for mediums.

Furthermore, the interaction variables important for achievement might depend on the content area. Giving help, receiving help, and being off-task related to achievement in studies examining fractions, probability, and algebra (Peterson & Janicki, 1979; Webb, 1980a,b,c, Note 1), but not in the present study examining general mathematics skills. Further studies with carefully defined combinations of group composition, ability, personality, interaction, and achievement are needed to establish general links among these variables.

Suggestions for Further Research

The first suggestion for further research concerns the logistics of observing group interaction. The note-taking procedures used in this study did not successfully capture much of the richness in group discussions. Videotaping or audiotaping the group work would increase the amount of detail recorded and may help resolve ambiguous interaction.

A second suggestion is to examine the effects of mixed ethnic backgrounds in a group on interaction and achievement. In light of the importance of active participation for achievement, Cohen's (1972; and Roper, 1972) findings that white students tend to be more active and influential than black students in small groups suggest that the achievement of minority students in mixed groups may suffer. What also needs to be examined systematically is whether improved race relations in mixed groups (Sharan, 1980; Slavin, 1980a,b) are directly associated with increased achievement.

A final suggestion is to distinguish the material that students already know from the material that is new. One study reported that some settings were advantageous for learning new material, whereas other settings were best for performance of previously learned material (Webb, 1980d). Further, the interaction variables effective for learning new material (e.g., receiving explanations) were not necessarily beneficial for performing previously learned material.

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1. Webb, N. M. Learning in individual and group settings. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April 1979.

2. Webb, N. M. Verbal interaction and learning in the classroom. Unpublished manuscript, 1981.

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Footnotes

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[1]In some groups all students except one came from the same ability stratum. To determine whether these groups were uniform or mixed, the following decision rules were applied. A group was defined as mixed if the standard deviation of ability within the group was greater than 1.00. If the standard deviation was less than 1.00, the group was defined as uniform for the three students from the same ability stratum.

[2]Approximately 10% of the students were absent when the extroversion-introversion scale was administered. Absentees came from all ability levels and were evenly distributed across types of grouping. Because missing scores were not related to any of the variables in the study, they were replaced by the mean of the sample.

[3]In a replication of this study (Webb, Note 2), extroversion-interversion scores obtained before and after group interaction correlated .98 and had identical means. Because the group interaction experience did not change extroversion-introversion scores, the scores obtained after group interaction in the present study were believed to be a reliable proxy for pre-interaction extroversion-introversion.

Table 1

Means and Standard Deviations of Ability, Extroversion-Introversion, Achievement, and Group Interaction Variables

Variable	Uniform-Ability (n=48)		Mixed-Ability (n=48)	
	M	SD	M	SD
Ability[a]	6.45	1.34	6.24	1.50
Extroversion-introversion	16.68	2.70	15.98	2.67
Achievement	25.33	7.74	28.02	9.20
Group interaction variables				
Student gives help	1.31	1.26	1.38	1.51
Student receives help	1.73	1.42	1.38	1.23
Student asks a question	2.38	1.84	1.92	1.47
receives a response	1.31	1.42	1.60	1.63
receives no response	1.06	1.19	0.31	0.62
Student works alone	3.79	1.65	3.69	1.52
Student interacts with another student (task-related, nonspecific)	4.17	3.10	4.23	3.29
Student is off-task	0.40	0.87	0.27	0.89

[a]Stanine scores

Table 2

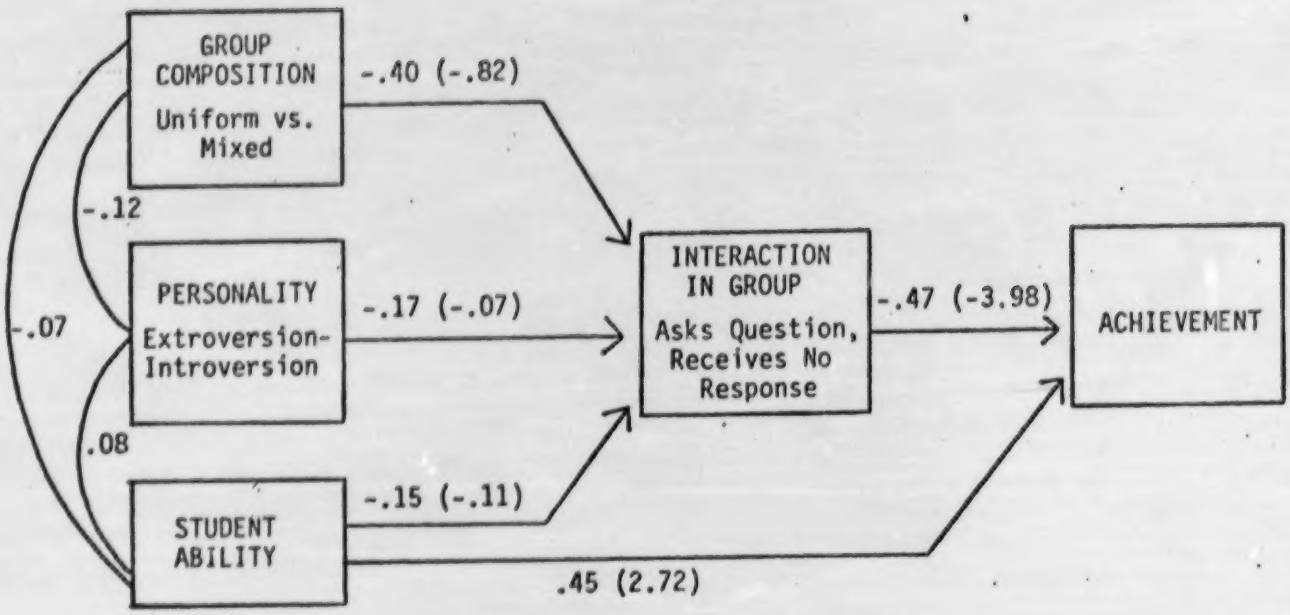
Actual and Reproduced Correlations Among Variables in Explanatory Model

	Group Composition	Personality	Ability	Interaction In Group	Achievement
Group Composition	--	-.12	-.07	-.37	.16
Personality	-.12	--	.08	-.14	.14
Ability	-.07	.08	--	-.14	.52
Interaction in Group	-.37	-.13	-.15	--	-.54
Achievement	.14	.10	.52	-.54	--

Note: Actual correlations appear above the diagonal; reproduced correlations appear below the diagonal.

Figure Captions

Figure 1. Path model of inputs, process and outcome. (Numbers without parentheses are standardized partial regression coefficients. Numbers in parentheses are unstandardized partial regression coefficients. Numbers on curved lines are zero-order correlation coefficients. Group composition was coded: uniform = 1; mixed = 2.)


GROUP COMPOSITION
Uniform vs. Mixed
-.40 (-.82)
-.12
PERSONALITY
Extroversion-Introversion
-.17 (-.07)
-.07
.08
STUDENT ABILITY
-.15 (-.11)
.45 (2.72)
INTERACTION IN GROUP
Asks Question, Receives No Response
-.47 (-3.98)
ACHIEVEMENT